meridian of Chicago, which I consider well determined with reference to the meridian of Greenwich.

I have already thus connected nine important points between Erie, Pennsylvania, and Prairie du Chien on the Mississippi river, and determined approximately their latitudes; but I have not time, at this moment, to add them here. I will, however, offer them at a future time, and as soon as I can arrange them in a brief form. They go to show that portions of the upper Mississippi river are laid down, even on the latest and most approved maps, several miles out of place in longitude.

I wish to offer this paper, as it is, for publication in the Society's Proceedings, provided it be considered acceptable.

J. D. GRAHAM,
Member of the Society.

CONTRIBUTIONS TO GEOGRAPHY, No. 2.

On the Latitude and Longitude of four additional positions on Lake Michigan, and of Madison, *the Capital of the State of Wisconsin; from astronomical observations by Lieut. Colonel J. D. Graham, U. S. Corps of Topographical Engineers.*

Chicago, Illinois, December 14th, 1858.

To the American Philosophical Society, Philadelphia.

In my letter of the 29th ultimo, I offered for the consideration of the Society, and for publication in its Proceedings, some observations on the latitude and longitude of Chicago.

I beg leave now to offer, for the same, the following observations in a brief form, made between the 20th of June and the 7th of September, 1858, for the determination of the geographical positions of the following places. Calling Chicago I, as already presented, I will enumerate the others, for convenient reference, as follows, viz:—

II. MICHIGAN CITY, INDIANA.
III. WAUKEGAN, ILLINOIS.
IV. RACINE, WISCONSIN.
V. MILWAUKEE, WISCONSIN.
VI. MADISON, THE CAPITAL OF WISCONSIN.

The instruments used for the observations were all of a portable character, adapted to ready use at night, whenever I had occasion to halt in the course of a long journey by rail road.

I will describe them as follows, viz:—

1. A sextant of $7\frac{1}{4}$ inches radius, made by Simms, of London, reading by aid of the vernier to 10 seconds of arc.
2. An artificial horizon of quicksilver.
3. A sidereal chronometer No. 2557, by Parkinson and Frodsham, of London; beats half-seconds.
4. A mean solar chronometer No. 141, by Isaiah Lukens, of Philadelphia; beats half-seconds. This chronometer runs eight days without winding. It was made by Mr. Lukens about the year 1830 or 1831, while on a visit to London. It is one of the earliest chronometers, I know of, made by an American. It is now an excellent time-keeper.

The latitudes, as will be seen, are derived from observed circum-meridian altitudes of stars arranged in pairs, one of each pair passing the meridian to the north and the other to the south of the zenith. When it could be done, they were selected of such declinations as to cause them to pass the meridian at altitudes varying only a few degrees, say 2° to 3°. But this last mentioned advantage for a close elimination of errors could not always be secured on the occasions here presented. There is, however, an approximate elimination from having one of the stars of each pair to pass the meridian to the north and the other to the south of the zenith.

The time stars were selected also in pairs, the one being observed eastward and the other westward of the meridian, and conformable, as nearly as was practicable under the circumstances attending each case, to the principle stated in my communication of the 29th ultimo.

The longitudes are all derived from chronometrical comparisons with the meridian of Chicago. They rest, for accuracy, on the correctness of my determination, in the year 1842, of the longitude of the citadel of Quebec, west of Greenwich, already alluded to in my previous communications, and on the sextant observations for the time at Chicago and at the several places whose longitudes are sought.

All the comparisons of time with the meridian of Chicago,—now assumed as a primary for my operations in our western country,—were by means of electric signals transmitted forth and back along the telegraphic wires.

The system adopted was as follows:—The night before visiting a place whose geographical position was to be ascertained, observations were made for the time at Chicago, with the sextant, the artificial horizon of quicksilver, and the sidereal chronometer. Both before and after these observations the sidereal and mean solar chronometers were compared. This gave the error of the first on sidereal, and of the second on mean solar time for the meridian of the Chicago observing station. Immediately on returning to Chicago the same thing was again done. This gave a new determination of the errors for the second Chicago period, and also the rates of both chronometers during the elapsed time.

Between these two periods the journey forth and back was made, and also the observations at the place whose position was sought, and the telegraphic signals exchanged, in the manner hereinafter reported.

The mean solar chronometer was always left at Chicago, and the signals sent from that place, as well as those sent to Chicago, were noted by it there.

The observations at the distant station, whose position was sought, and the telegraphic signals received at and sent from that station, were all noted there by the sidereal chronometer. These signals were always made by myself by pressing the telegraph key with the fingers, so as to produce the click of that key as nearly as possible in coincidence with a given beat of the chronometer.

The signals at Chicago were always made by an experienced telegraph operator, who was, in the beginning, carried through a course of practice in making dots as nearly as possible in coincidence with the beats of the mean solar chronometer at every ten seconds of interval, for seven to ten and sometimes thirteen minutes as a series. It is remarkable how soon a person, with a good ear for cadence, or time, will acquire an accuracy in making these time-signals approaching almost to exactness. The results which will presently be presented will serve as evidence on this point.

After the observations for the time, at the place visited, were completed, the sidereal chronometer was carried to the telegraph office at that place. I then began by calling for a certain number of signals from Chicago at intervals of ten seconds apart, sufficient to insure two or three periods of coincidence in the beats of the two chronometers.

This period of coincidence of beats having been thus ascertained, signals were sent from the distant station back to Chicago, at intervals that would ensure a coincidence with the beats of both chronometers. These intervals were easily ascertained by making allowance for the difference of the rates of the two chronometers affected by their proper algebraic signs of + when gaining, and — when losing, as well as for the gain of sidereal on mean solar time.

Sometimes additional signals were called for from Chicago at stated moments, varying the interval two, three, or four seconds, each way, and sometimes throwing them into the half-second beats, and at others into the whole-second beats at that place, as tests upon the series. The reductions from Chicago mean solar to sidereal time, with the difference of the rates of the two chronometers incorporated into the calculations, give the fractions of a second which appear in the stated differences of longitude between the two stations—the signals corresponding to coincident beats of the two chronometers being the only ones used in the computations.

I will now proceed to state, in a brief form, the observations and the results derived from them.

The Observations for Time at Chicago.

1*st*. 1858, *June* 20*th*. *At Chicago Observing Station No.* 2, *in latitude* 41° 53′ 50″.5 *N.: longitude* 5*h*. 50*m*. 31*s*.15 *W.*

Sidereal chronometer No. 2557, fast:	
	m. *s.*
By 11 observations on α Lyræ, east (at 15*h*. 40*m*. sidereal) - - - - -	59 18.93
By 12 observations on α Bootis, west (at 16*h*. 13*m*. sidereal) - - - - -	59 18.32
Result—Chronometer No. 2557, fast of sidereal time for this station (at 15*h*. 56*m*. sidereal) -	+ 59 18.62
By comparison—Chronometer No. 141, slow of mean solar time for this station (at 10*h*. 00*m*. mean time)	— 4 59.07

2*d*. *June* 22*d*. *Same Station.*

Sidereal chronometer No. 2557, fast:	*m.* *s.*
By 14 observations on α Lyræ, E. (at 15*h*. 36*m*.)	59 30.90
By 16 observations on α Bootis, W. (at 16*h*. 10*m*.)	59 30.53
Result—Chronometer No. 2557, fast of sidereal time for this station (at 15*h*. 53*m*.) - -	+ 59 30.71
By comparison—Chronometer No. 141, slow of mean solar time for this station (at 9*h*. 48*m*. mean time)	— 4 58.33

3*d*. 1858, *June* 28*th*. *Same Station.*

	h. m. s.
Sidereal chronometer No. 2557, fast:	
By 10 observations on α Lyræ, E. (at 15*h*. 37*m*.)	1 00 07.92
By 12 observations on α Bootis, W. (at 16*h*. 08*m*.)	1 00 07.20
Result—Chronometer No. 2557, fast of sidereal time for this station (at 15*h*. 52*m*.) - -	+ 1 00 07.56
By comparison—Chronometer No. 141, slow of mean solar time for this station (at 9*h*. 25*m*.) -	— 4 53.75

4*th*. *June* 30*th*. *At Chicago Observing Station No.* 3, *in latitude* 41° 53′ 46″.3 *N*., *longitude* 5*h*. 50*m*. 31*s*.2. *W*.

	h. m. s.
Sidereal chronometer No. 2557, fast:	
By 10 observations on α Coronæ Borealis, W. (at 19*h*. 22*m*.) - - - - -	1 00 21.22
By 13 observations on α Andromedæ, E. (at 20*h*. 08*m*.) - - - - -	1 00 20.48
Result—Chronometer No. 2557, fast of sidereal time for this station (at 19*h*. 45*m*.) - -	+ 1 00 20.85
By comparison—Chronometer No. 141, slow of mean solar time for this station, (at 13*h*. 09*m*. mean time)	— 4 53.1

5*th*. 1858, *July* 3*d*. *At Chicago Observing Station No.* 2.

Sidereal chronometer No. 2557, fast:

	h. m. s.
By 6 observations on α Lyræ, E. (at 16*h*. 12*m*.) - - -	1 00 36.95
By 12 observations on α Cygni, also east (at 17*h*. 13*m*.) - -	1 00 37.40

	h. m. s.
By a mean of the results from two East stars (at 16*h*. 42*m*.) - - - - -	1 00 37.17
By 14 observations on α Bootis, W. (at 16*h*. 38*m*.)	1 00 37.03
Result—Chronometer No. 2557, fast of sidereal time for this station (at 16*h*. 40*m*.) - -	+ 1 00 37.1
By comparison—Chronometer No. 141, slow of mean solar time for this station (at 9*h*. 53*m*. mean time)	— 4 50.53

6th. July 5th. At Chicago Observing Station No. 3.

Sidereal chronometer No. 2557, fast:

	h. m. s.
By 14 observations on α Coronæ Borealis, W. (at 19*h*. 28*m*.) - - - - -	1 00 50.08
By 18 observations on α Andromedæ, E. (at 20*h*. 00*m*.)	1 00 49.97
Result—Chronometer No. 2557, fast of sidereal time for this station (at 19*h*. 44*m*.) - -	+ 1 00 50.02
By comparison—Chronometer No. 141, slow of mean solar time for this station (at 12*h*. 48*m*. mean time)	— 4 49.38

7th. 1858, July 7th. At Chicago Observing Station No. 2.

Sidereal chronometer No. 2557, fast:

	h. m. s.	h. m. s.
By 5 observations on α Lyræ, E. (at 15*h*. 27*m*.) using horizon roof No. 1, being an old one in use 18 years, -	1 01 00.06	
By 8 observations on α Bootis, W. (at 16*h*. 17*m*.) with same roof, -	1 00 59.34	
By E. and W. stars (at 15*h*. 52*m*.) using horizon roof No. 1,	+ 1 00 59.7	
		+ 1 00 59.70
By 5 observations on α Lyræ, E. (at 15*h*. 36*m*.) using horizon roof No. 2, a new one, - - -	1 00 59.91	
By 7 observations on α Bootis, W. (at 16*h*. 02*m*.) also using roof No. 2,	1 00 59.41	
By the same E. and W. stars (at 15*h*. 49*m*.), using horizon roof No. 2,	+ 1 00 59.66	
		+ 1 00 59.66
Result—Chronometer No. 2557, fast of sidereal time for this station (at 15*h*. 50*m*.) by 10 observations on α Lyræ, E.; 15 observations on α Bootis, W.		+ 1 00 59.68
By comparison—Chronometer No. 141, slow of mean solar time for this station (at 8*h*. 48*m*. mean time)		— 4 48.79

8th. 1858, *July* 12*th.* *At Chicago Observing Station No.* 2.

Sidereal chronometer No. 2557, fast:		
By 10 observations on α Lyræ, E. (at 15*h.* 32*m.*) using horizon roof No. 1, - - -	*h. m. s.* 1 01 30.12	
By 14 observations on α Bootis, W. (at 16*h.* 12*m.*) also using roof No. 1. - - -	1 01 30.41	
By E. and W. stars, using roof No. 1 (at 15*h.* 52*m.*) -	+1 01 30.26	*h. m. s.*
		+1 01 30.26
By 5 observations on α Lyræ, E., using horizon roof No. 2 (at 15*h.* 45*m.*) - - -	1 01 30.	
By 8 observations on α Bootis, W., using roof No. 2 (at 15*h.* 57*m.*) ·	1 01 30.22	
By E. and W. stars (at 15*h.* 51*m.*) using roof No. 2, .	+1 01 30.11	
		+1 01 30.11

Result—Chronometer No. 2557, fast of sidereal time for this station (at 15*h.* 51*m.* 30*s.*) by 15 observations on α Lyræ, east, and 22 observations on α Bootis, west, - - - +1 01 30.18

By comparison—Chronometer No. 141, slow of mean solar time for this station (at 8*h.* 28*m.* mean time) —4 44.48

9th. 1858, *July* 15*th.* *At Chicago Observing Station No.* 3.

Sidereal chronometer No. 2557, fast:	
By 7 observations on α Coronæ Borealis, W. (at 19*h.* 06*m.*) using horizon roof No. 1, - -	*h. m. s.* 1 01 46.54
By 5 observations on α Andromedæ, E. (at 20*h.* 18*m.*) using also roof No. 1, - - -	1 01 44.96

By E. and W. stars (at 19*h*. 42*m*.)	*h. m. s.*	
using horizon roof No. 1,	+ 1 01 45.75	*h. m. s.*
		+ 1 01 45.75
By 6 observations on α Coronæ Borealis, W. (at 19*h*. 24*m*.) using horizon roof No. 2, - -	1 01 46.04	
By 9 observations on α Andromedæ, E. (at 20*h*. 02*m*.) using also horizon roof No. 2, - -	1 01 45.31	
By E. and W. stars (at 19*h*. 43*m*.) using horizon roof No. 2,	+ 1 01 45.68	
		+ 1 01 45.68

Result—Chronometer No. 2557, fast of sidereal time for this station (at 19*h*. 42*m*. 30*s*.) by 13 observations on α Coronæ Borealis, W., and 14 observations on α Andromedæ, E. - - + 1 01 45.71

By comparison—Chronometer No. 141, slow of mean solar time for this station (at 12*h*. 07*m*. mean time), — 4 44.58

10*th*. 1858, *July* 18*th*. *At Chicago Observing Station No.* 2.

Sidereal chronometer No. 2557, fast:

By 9 observations on α Lyræ, E. (at	*h. m. s.*	
15*h*. 58*m*.) - - -	1 02 01.85	
By 14 observations on α Cygni, also E. (at 17*h*. 18*m*.) - -	1 02 01.75	
		h. m. s.
By 23 observations on 2 East stars (at 16*h*. 38*m*.)		1 02 01.8
By 19 observations on α Bootis, W. (at 16*h*. 34*m*.)		1 02 01.42

Result—Chronometer No. 2557, fast of sidereal time for this station (at 16*h*. 36*m*.) - + 1 02 01.61

By comparison—Chronometer No. 141, slow of mean solar time for this station (at 8*h*. 49*m*.) - — 4 43.01

11*th*. 1858, *July* 21*st*. *At same Station, No.* 2.

Sidereal chronometer No. 2557, fast:

By 7 observations on α Bootis, W. (at 16*h*. 37*m*.) using horizon roof No. 1, - - -	*h. m. s.* 1 02 17.31	
By 8 observations on α Cygni, E. (at 17*h*. 19*m*.) using, also, horizon roof No. 1, - - -	1 02 18.39	
By E. and W. stars (at 16*h*. 58*m*.) with horizon roof No. 1,	+ 1 02 17.85	*h. m. s.* + 1 02 17.85
By 8 observations on α Bootis, W. (at 16*h*. 50*m*.) with roof No. 2, -	1 02 17.68	
By 8 observations on α Cygni, E. (at 17*h*. 02*m*.) also with roof No. 2,	1 02 18.03	
By E. and W. stars (at 16*h*. 56*m*.) using horizon roof No. 2,	+ 1 02 17.85	+ 1 02 17.85

Result—Chronometer No. 2557, fast of sidereal time for this station (at 16*h*. 57*m*.) by 15 observations on α Bootis, west, and 16 observations on α Cygni, east, - - - - - + 1 02 17.85

By comparison—Mean solar chronometer No. 141, slow of mean solar time for this station (at 8*h*. 58*m*. mean time) - - - - — 4 41.75

12*th*. 1858, *September* 5*th*. *At Chicago Observing Station No.* 3.

Sidereal chronometer No. 2557, fast:

By 10 observations on α Coronæ Borealis, W. (at 19*h*. 04*m*.) - - - - -	*h. m. s.* 1 06 53.8
By 12 observations on α Andromedæ, E. (at 20*h*. 25*m*.) - - - - - .	1 06 54.7

Result—Chronometer No. 2557, fast of sidereal time for this station (at 19*h*. 45*m*.) - - + 1 06 54.25

By comparison—Chronometer No. 141, slow of mean solar time for this station (at 8*h*. 45*m*. mean time), — 4 28.5

13*th*. 1858, *September 7th*. *Same Station, No*. 3.

Sidereal chronometer No. 2557, fast:

		h. m. s.
By 9 observations on α Andromedæ, east (at 20*h*. 24*m*.) - - - - -		1 07 06.7
	h. m. s.	
By 15 observations on α Lyræ, W. (at 22*h*. 21*m*.) - - -	1 07 06.51	
By 8 observations on α Aquilæ, also W. (at 22*h*. 23*m*.) - -	1 07 06.53	
By 23 observations on 2 West stars (at 22*h*. 22*m*.) . -	1 07 06.52	
		1 07 06.52
Result—Chronometer No. 2557, fast of sidereal time for this station (at 21*h*. 23*m*.) -		+ 1 07 06.62
By comparison—Chronometer No. 141, slow of mean solar time for this station (at 10*h*. 15*m*. mean time)		— 4 28.36

I would have preferred α Coronæ Borealis, W. for combination with α Andromedæ, E., as they are nearly of the same north declination, but clouds in the early part of the night obscured him.

Rates of the Chronometers.

As the rates of the two chronometers are necessarily introduced into the computations, it is proper that they should be here exhibited as derived from the foregoing observations made at Chicago.

They are as follows, viz.—

1*st. Rates of Sidereal Chronometer No.* 2557.

1858.		Elapsed Sidereal interval.	Rate per 24 Sidereal Hours.
From	To	Days and Decimals.	Gaining.
			s.
June 20,	June 22,	1.998	+ 6.05
June 22,	June 28,	6.000	+ 6.14
June 28,	June 30,	2.162	+ 6.15
June 30,	July 3,	2.870	+ 5.66
July 3,	July 5,	2.127	+ 6.07
July 5,	July 7,	1.837	+ 5.27
July 7,	July 12,	5.000	+ 6.10
July 12,	July 15,	3.160	+ 4.91
July 15,	July 18,	2.871	+ 5.54
July 18,	July 21,	3.014	+ 5.39
September 5,	September 7,	2.079	+ 6.00

2*d. Rates of Mean Solar Chronometer No.* 141.

1858.		Elapsed Mean Solar interval.	Rate per 24 Mean Solar Hours.
From	To	Days and Decimals.	+ Gaining. — Losing.
			s.
June 20,	June 22,	1.992	+ 0.37
June 22,	June 28,	5.983	+ 0.76
June 28,	June 30,	2.155	+ 0.30
June 30,	July 3,	2.860	+ 0.90
July 3,	July 5,	2.120	+ 0.54
July 5,	July 7,	1.833	+ 0.32
July 7,	July 12,	4.986	+ 0.86
July 12,	July 15,	3.152	— 0.03
July 15,	July 18,	2.862	+ 0.55
July 18,	July 21,	3.006	+ 0.42
September 5,	September 7,	2.064	+ 0.07

I will now present, in the same brief form as in the case of Chicago (I.), the observations that were made to ascertain the latitude and longitude of the other stations, following the order laid down at the beginning of this paper. It is the order in which the places occur in going from south to north.

II. MICHIGAN CITY, INDIANA.

The station occupied was on the summit of a sand hill, about 350 yards north-easterly from the rail road depot. A connection will be made by survey, as soon as convenient, between the observing station and one of the church steeples, and will be reported.

1*st. Observations for the Latitude.* 1858, *June* 21*st.*

By 10 observed circum-meridian altitudes of β Libræ, south, combined with 5 observed altitudes of Polaris (α Ursæ Minoris), north; latitude (approximate) - - - - -	41° 43′ 25″

2*d. Observations for the Time. Same Night.*

Sidereal chronometer No. 2557, fast:	*m.* *s.*
By 13 observations on α Lyræ, east (at 15*h.* 36*m.*)	56 31.4
By 14 observations on α Bootis, west (at 16*h.* 08*m.*)	56 30.5
Result—Sidereal chronometer No. 2557, fast of sidereal time for this station (at 15*h.* 52*m.*) - -	+ 56 30.95

3*d. The Longitude.*

This was determined the same night by chronometrical connections with the meridian of Chicago, by means of electric signals transmitted each way by the telegraph wires. The times at the two stations were derived from the above observations made this night at Michigan city, and the observations made at Chicago on the nights of the 20th and 22d inst. above given, which also determine the rates of the two chronometers for reduction to the times of the signals.

The whole operation is shown as follows, viz.—

Determination of the difference of Longitude between Chicago and Michigan City, Indiana, by electric signals for comparisons of time, June 21st, 1858.

Sidereal Chronometer No. 2557, fast, of Michigan City, sidereal time, (at 16*h*. 57*m*. sidereal time,) + 56*m*. 31*s*.22.

Rate per sidereal day, + 6*s*.05; or per sidereal hour, + 0*s*.250.

Mean solar Chronometer No. 141, slow, of Chicago, mean solar time, (at 10*h*. 54*m*. mean time,) — 4*m*. 58*s*.68.

Rate per mean solar day, + 0.37*s*; or per mean solar hour, + 0*s*.015.

1st.—Chicago signals recorded at both stations.

Times of signals given at Chicago, by mean solar Chronometer No. 141.	Correct Chicago mean solar time of Chicago signals.	Times of Chicago signals, as noted at Michigan City by sidereal Chronometer No. 2557.	Michigan City correct sidereal time of Chicago signals.	Chicago reduced sidereal time of Chicago signals.	Difference of Longitude by each signal.—Michigan City east of the meridian of Chicago.
h. m. s	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
11 00 00	11 04 58.68	18 04 44.5	17 08 13.23	17 05 19.45	0 02 53.78
11 18 00	11 22 58.68	18 22 47.5	17 26 16.16	17 23 22.40	0 02 53.76
12 02 30	12 07 28.67	19 07 25.	18 10 53.47	18 07 59.70	0 02 53.77
12 05 30	12 10 28.67	19 10 25.5	18 13 53.96	18 11 00.20	0 02 53.76
12 11 30	12 16 28.66	19 16 26.5	18 19 54.93	18 17 01.17	0 02 53.76
12 14 30	12 19 28.66	19 19 27.	18 22 55.42	18 20 11.66	0 02 53.76
12 17 20	12 22 18.66	19 22 17.5	18 25 45.91	18 22 52.13	0 02 53.78
12 20 40	12 25 38.66	19 25 38.	18 29 06.40	18 26 12.67	0 02 53.73

1st Mean.—Electric signals sent from Chicago to Michigan City, 0 02 53.763

2d.—Michigan City signals recorded at both stations.

Times of signals given at Michigan City, by sidereal Chronometer No. 2557.	Times of Michigan City signals as noted at Chicago, by mean solar Chronometer No. 141.	Chigago correct mean solar time of Michigan City signals.	Chicago reduced sidereal time of Michigan City signals.	Michigan City correct sidereal time of Michigan City signals.	Difference of Longitude by each signal.—Michigan City east of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m s.*	*h. m. s.*	*h. m. s.*
17 53 30	10 48 47.5	10 53 46.18	16 54 05.11	16 56 58.78	0 02 53.67
18 49 30	11 44 38.	11 49 36.67	17 50 04.77	17 52 58.55	0 02 53.78
18 53 00	11 48 07.5	11 53 06.17	17 53 34.84	17 56 28.53	0 02 53.69

2d Mean.—Electric signals sent from Michigan City to Chicago, 0 02 53.713

1st Mean.—Electric signals sent from Chicago to Michigan City, as above, - - - - . - - 0 02 53.76

Result:—Michigan City Observing Station, east in longitude of Chicago observing Station No. 2, by a mean of the two sets of signals, - - - - - - - 0 02 53.74

	h. m. s.
Brought forward,	— 0 02 53.74
Chicago observing station No. 2, west of the meridian of Greenwich, - - - -	+ 5 50 31.15
Result—Michigan city observing station, west of the meridian of Greenwich, - - -	+ 5 47 37.41
Equal, in arc, to - - - -	86° 54′ 21″.15 W.
Latitude (approximate) of the same station, as above,	41° 43′ 25″ N.

III. WAUKEGAN, ILLINOIS.

The point of observation here was 111 feet north of the parallel of, and 103 feet west of the meridian of, the dome of the Court House, = 1″.1 difference of latitude; and 0*s*.09 in time, difference of longitude.

1*st*. *Observations for the Latitude.* 1858, *June* 29*th*.

	° ′ ″	° ′ ″
By 3 observed circum-meridian altitudes of β Libræ, south,	42 21 41.6	
By 11 observed circum-meridian altitudes of α Ophiuchi, also south,	42 21 44.	
Mean from 2 south stars, - - -		42 21 42.8
By 10 observed altitudes of Polaris (α Ursæ Minoris) north, - - - - -		42 21 46.7
Result—Latitude of station, - - -		42 21 44.8
Reduction to the dome of the Court House, -		— 1.1
Latitude of Waukegan Court House, - -		42 21 43.7

2*d*. *Observations for the Time.*

Sidereal chronometer No. 2557, fast:	h. m. s.
By 13 observations on α Lyræ, east (at 15*h*. 44*m*.)	1 01 04.08
By 12 observations on α Bootis, west (at 16*h*. 19*m*.)	1 01 03.22
Result—Sidereal chronometer No. 2557, fast of sidereal time for this observing station (at 16*h*. 01*m*.)	+ 1 01 03.65

3d. *The Longitude.*

Reference must be made to the observations for the time at this place as above given, and to those of June 28th, and June 30th, at Chicago. They furnish the data for the times at each station, applied to the following telegraphic signals exchanged between Chicago and Waukegan, viz:

Determination of the difference of Longitude between Chicago and Waukegan, Illinois, by electric signals for comparison of time, June 29th, 1858.

Sidereal Chronometer No. 2557, fast of Waukegan sidereal time (at 18*h.* 29*m.* sidereal time), 1*h.* 01*m.* 04*s.*28.

Rate per sidereal day, + 6.15*s.* or per sidereal hour, + 0*s.*2506.

Mean Solar Chronometer No. 141, slow of Chicago mean solar time (at 11*h.* 58*m.* mean time), 04*m.* 53*s.*42.

Rate per mean solar day, + 0*s.*30. or per mean solar hour, 0*s.*0125.

1st.—Chicago signals recorded at both stations.

Times of Signals given at Chicago, by mean solar Chronometer No. 141.	Correct Chicago mean solar time of Chicago signals.	Times of Chicago signals, as noted at Waukegan, by sidereal Chronometer No. 2557.	Waukegan correct sidereal time of Chicago signals.	Chicago reduced sidereal time of Chicago signals.	Difference of Longitude by each signal. Waukegan, west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
11 53 20	11 58 13.42	19 30 30	18 29 25.72	18 30 15.40	0 00 49.68
11 56 20	12 01 13.42	19 33 30.5	18 32 26.20	18 33 15.90	0 00 49.70
11 59 20	12 04 13.42	19 36 31	18 35 26.69	18 36 16.39	0 00 49.70
1st Mean.—Electric signals sent from Chicago to Waukegan, Ill.					0 00 49.69

2d.—Waukegan, Illinois, signals recorded at both stations.

Times of signals given at Waukegan, by sidereal Chronometer No. 2557.	Times of Waukegan signals, as noted at Chicago, by mean solar Chronometer No. 141.	Chicago correct mean solar time of Waukegan signals.	Chicago reduced sidereal time of Waukegan signals.	Waukegan correct sidereal time of Waukegan signals.	Difference of Longitude by each signal. Waukegan, west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
19 45 25	12 08 12.5	12 13 05.91	18 45 10.34	18 44 20.65	0 00 49.69
19 48 25.5	12 11 12.5	12 16 05.91	18 48 10.83	18 47 21.14	0 00 49.69
19 51 26	12 14 12.5	12 19 05.91	18 51 11.32	18 50 21.63	0 00 49.69
19 54 26.5	12 17 12.5	12 22 05.91	18 54 11.81	18 53 22.12	0 00 49.69
2d Mean.—Electric signals sent from Waukegan, Ill. to Chicago,					0 00 49.69
1st Mean.—Electric signals sent from Chicago to Waukegan as above,					0 00 49.69

Result:—Waukegan Station, Illinois, west in longitude of Chicago observing station No. 2, by a mean of the two sets of signals, + 0 00 49.69

	h. m. s.
Brought forward,	+ 0 00 49.65
Reduction to Waukegan Court House, - -	— 0.09
Waukegan Court House, west of the meridian of Chicago observing station No. 2, -	+ 0 00 49.56
Longitude of Chicago observing station No. 2, west of the meridian of Greenwich, -	+ 5 50 31.15
Longitude of Waukegan Court House, west of the meridian of Greenwich, - - -	5 51 20.71
Equal, in arc, to - - -	87° 50′ 10″.65 W.
Latitude, as before, - - -	42° 21′ 43″.7 N.

Other points at Waukegan, connected with the dome of the Court House by survey, are obtained for the following table, viz.—

POSITIONS IN WAUKEGAN.	Latitude North.	Longitude West of the Meridian of Greenwich.	
		In Arc.	In Time.
	° ′ ″	° ′ ″	h. m. s.
1st. Dome of Waukegan Court House, - - - - - - - - - -	42 21 43.7	87 50 10.65	5 51 20.71
2d. Steeple of the Roman Catholic Church on County Street, between Water and Washington Streets, - - - - - - - - - -	42 21 37.7	87 50 11.44	5 51 20.76
3d. Intersection of the middle of Genesee Street with the middle of Washington Street, - - -	42 21 41.	87 50 05.8	5 51 20.33
4th. The Light House, - - - -	42 21 29.3	87 49 59.97	5 51 20.
5th. Intersection of the middle of Madison Street with the shore of Lake Michigan, - - - - -	42 21 44.2	87 49 39.93	5 51 18.66

IV. RACINE, WISCONSIN.

The observing station here, is S. 44° 42′ 40″ E. 100 feet from the middle of the base of the tower of Saint Luke's Church (Episcopal); and it is N. 87° 05′ E. and distant 297 feet from the dome of the Racine Court House, situated 100 feet west of the west margin of Main street, between 5th and 6th streets.

1*st. Observations for the Latitude.* 1858, *September* 6*th.*

	° ′ ″
By 11 observed circum-meridian altitudes of Altair (α Aquilæ) south, - - - - -	42 43 46.3
By 11 observed circum-meridian altitudes of γ Cephei, north, - - - - - -	42 43 43.1
Result—Latitude of station, - - -	42 43 44.7 N.
Reduction to the dome of the Court House, -	— 0.1
Latitude of Racine Court House, - -	42 43 44.6

2*d. Observations for the Time. Same Night.*

Sidereal chronometer No. 2557, fast:

	h. m. s.
By 13 observations on α Coronæ Borealis, west (at 19*h.* 07*m.*) - - - - -	1 07 36.69
By 9 observations on α Andromedæ, east (at 20*h.* 26*m.*) - - - - - -	1 07 37.1
Result—Chronometer No. 2557, fast of sidereal time for this station (at 19*h.* 46*m.*) - -	+ 1 07 36.9

3*d. The Longitude.*

Reference must be made to the above observations made this night for the Racine time, and to the observations before recorded, of the 5th and 7th of September, made at Chicago for the time there, and also to the following telegraphic signals, viz:

Determination of the difference of Longitude between Chicago and Racine, Wisconsin, by electric signals for comparisons of time, September 6th, 1858.

Sidereal Chronometer No. 2557, fast, of Racine, sidereal time, (at 22*h.* 24*m.* 40*s.* siderial time,) 1*h.* 07*m.* 37*s.*55.

Rate per sidereal day, + 6*s.*0 ; or per sidereal hour, + 0*s.*25.

Mean Solar Chronometer No. 141, slow, of Chicago, mean solar time, (at 11*h.* 21*m.* mean time,) 4*m.* 28*s.*42.

Rate per mean solar day, + 0*s.*07 ; or per mean solar hour, + 00*s.*03.

1st.—Chicago signals recorded at both stations.

Times of Signals given at Chicago by mean solar Chronometer No. 141.	Correct Chicago mean solar time of Chicago signals.	Times of Chicago signals as noted at Racine by siderial Chronometer No. 2557.	Racine correct sidereal time of Chicago signals.	Chicago reduced sidereal time of Chicago signals.	Difference of Longitude by each signal.—Racine West of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
11 16 50	11 21 18.42	23 32 17.5	22 24 39.95	22 25 16.75	0 00 36.80
11 19 40	11 24 08.42	23 35 08.	22 27 30.43	22 28 07.22	0 00 36.79
11 31 40	11 36 08.42	23 47 10.	22 39 32.38	22 40 09.19	0 00 36.81
11 34 42	11 39 10.42	23 50 12.5	22 42 34.87	22 43 11.68	0 00 36.81
11 37 41	11 42 09.42	23 53 12.	22 45 34.36	22 46 11.17	0 00 36.81

1st Mean.—Electric signals sent from Chicago to Racine, 0 00 36.804

2d.—Racine signals recorded at both stations.

Times of signals given at Racine by sidereal Chronometer No. 2557.	Times of Racine signals as noted at Chicago by mean solar Chronometer No. 141.	Chicago correct mean solar time of Racine signals.	Chicago reduced sidereal time of Racine signals.	Racine correct sidereal time of Racine signals.	Difference of Longitude by each signal.—Racine West of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
23 38 08.5	11 22 40.	11 27 08.42	22 31 07.71	22 30 30.92	0 00 36.79
23 41 09.	11 25 40.	11 30 08.42	22 34 08.20	22 33 31.41	0 00 36.79
23 44 10.5	11 28 41.	11 33 09.42	22 37 09.69	22 36 32.90	0 00 36.79

2d Mean.—Electric signals sent from Racine to Chicago, 0 00 36.79

1st Mean.—Electric signals sent from Chicago to Racine, as above, 0 00 36.804

Result :—Racine observing station is west, in longitude of Chicago observing Station No. 3, by a mean of the two sets of signals, - - - - - - + 0 00 36.80

	h. m. s.
Brought forward,	+ 0 00 36.8
Reduction to the dome of Racine Court House,	+ 0.26
Sum,	0 00 37.06
Longitude of Chicago observing station No. 3, west of the meridian of Greenwich, - -	+ 5 50 31.2
Longitude of Racine Court House, west of the meridian of Greenwich, - - - -	5 51 08.26
Equal, in arc, to - - - -	87° 47′ 04″
Latitude, as above, - - - -	42° 43′ 44″.6

From the above, and our survey, we present the following table of positions in Racine, viz.

POSITIONS IN RACINE.	North Latitude.	Longitude West of the Meridian of Greenwich.	
		In Arc.	In Time.
	° ′ ″	° ′ ″	h. m. s.
1st. Dome of the Court House, -	42 43 44.6	87 47 04	5 51 08.26
2d. Tower of St. Luke's Church (Episcopal), - - - - - - - -	42 43 45.4	87 47 01	5 51 08.06
3d. Steeple of the Universalist Church of the Good Shepherd, -	42 43 44.3	87 47 00.9	5 51 08.06
4th. The Light House, - - - -			

The American Almanac for the present year, and for many years past, gives Racine as being in latitude 42° 49′ 33″ N. Longitude west of Greenwich, 87° 40′ 22″ which is an error in the assigned position of this place of eight and three-fourths ($8\frac{3}{4}$) miles in an azimuthal direction of N. 40° 25′ east, of its true position.

V. MILWAUKEE, WISCONSIN.

This is the second city in magnitude, population and commerce, on Lake Michigan, being next to Chicago. It is also the largest city in the State of Wisconsin. Its population is now near fifty thousand (50,000) souls. It is very important that its position should be correctly laid down on the maps of our country.

I was obliged to occupy three different stations in the course of the observations made here, for reasons which will be stated in turn. The observations at each were reduced to the position of the tall and conspicuous steeple of the Roman Catholic Church on Jackson street, between Oneida and Biddle streets. This church is of permanent structure, and was therefore selected as a monument for reference.

1858, *June 23d. At Milwaukee Station No.* 1.

This station is in a vacant lot near the north-east corner of Milwaukee and Mason streets. The intersection of the middle lines or axes of these two streets, is 115 feet south of the parallel, and 107 feet west of the meridian of this observing station No. 1.

The middle point of the base of the tall steeple of the Roman Catholic Church on Jackson street, is by horizontal measurement, 545 feet $= 5''.38$ of arc in latitude north of the parallel, and 557 feet $= 7''.5$ of arc $= 0s.5$ of time east of the meridian of this observing station No. 1.

The observations made this night, for the latitude at this station, were not conclusive. I obtained here 14 circum-meridian altitudes of the star β Libræ, culminating south of the zenith, but clouds prevented observations on α Ursæ Minoris (Polaris) north; therefore those on β Libræ were rejected, although they gave the latitude of this station only $4''.6$ less than it was afterwards made by a reduction to this point, of satisfactory observations at stations Nos. 2 and 3, as will presently appear.

1. *Observations for the Time at Milwaukee Station No.* 1.

Sidereal chronometer No. 2557, fast:

	h.	*m.*	*s.*
By 10 observations on α Lyræ, east (at 15*h.* 42*m.* sidereal time) - - - - -	1	00	43.5
By 15 observations on α Bootis, west (at 16*h.* 08*m.* sidereal time) - - - - -	1	00	42.52

Result.—Chronometer No. 2557, fast of sidereal time for this station (at 15*h.* 55*m.* sidereal time, June 23d) - - - - - + 1 00 43.

2*d. The Longitude.*

The above determination of the time for this Milwaukee station, and the time at Chicago, derived from the observations of June 22d and 28th, already given, together with the comparisons of time for the two places by the following telegraphic signals, give us the data for the difference of longitude.

The elapsed time between the two periods of observation at Chicago, fixing the rate of mean solar chronometer No. 141, was greater than I would have wished, but I could not diminish it.

Determination of the difference of Longitude between Chicago and Milwaukee, by electric signals for comparisons of time, June 23d, 1858.

Sidereal Chronometer No. 2557, fast, of Milwaukee, sidereal time, (at 17*h.* 39*m.* sidereal time,) 1*h.* 00*m.* 43*s*.46.

Rate per sidereal day, + 6*s*.14 ; or per sidereal hour, + 0*s*.251.

Mean Solar Chronometer No. 141, slow, of Chicago, mean solar time, (at 11*h.* 32*m.* mean time,) 4*m.* 57*s*.51.

Rate per mean solar day, + 0*s*.76 ; or per mean solar hour, + 0*s*.0317.

1st.—Milwaukee signals recorded at both stations.

Times of signals given at Milwaukee by sidereal Chronometer No. 2557.	Times of Milwaukee signals as noted at Chicago by mean solar Chronometer No. 141.	Chicago correct mean solar time of Milwaukee signals.	Chicago reduced sidereal time of Milwaukee signals.	Milwaukee correct sidereal time of Milwaukee signals.	Difference of Longitude by each signal.—Milwaukee west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
18 40 00.	11 27 07.5	11 32 05.01	17 40 23.35	17 39 16.54	0 01 06.81
18 43 00.	11 30 07.	11 35 04.51	17 43 24.34	17 42 16.53	0 01 06.81

1st Mean.—Electric signals sent from Milwaukee to Chicago, 0 01 06.81

2d.—Chicago signals recorded at both stations.

Times of signals given at Chicago by mean solar Chronometer No. 141.	Correct Chicago mean solar time of Chicago signals.	Times of Chicago signals as noted at Milwaukee by sidereal Chronometer No. 2557.	Milwaukee correct sidereal time of Chicago signals.	Chicago reduced sidereal time of Chicago signals.	Difference of Longitude by each signal.—Milwaukee west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
11 48 00.	11 52 57.50	19 00 56.	18 00 12.47	18 01 19.27	0 01 06.80
12 15 00.	12 19 57.49	19 28 00.5	18 27 16.85	18 28 23.69	0 01 06.84
12 18 00.	12 22 57.49	19 31 01.	18 30 17.33	18 31 24.19	0 01 06.86
12 23 50.	12 28 47.48	19 36 52.	18 36 08.31	18 37 15.14	0 01 06.83
12 30 00.	12 34 57.48	19 43 03.	18 42 19.28	18 43 26.15	0 01 06.87
12 35 50.	12 40 47.47	19 48 54.	18 48 10.26	18 49 17.10	0 01 06.84
12 38 40.	12 43 37.47	19 51 44.5	18 51 00.75	18 52 07.57	0 01 06.82

2d Mean.—Electric signals sent from Chicago to Milwaukee, 0 01 06.83

1st Mean.—Electric signals sent from Milwaukee to Chicago, as above, - - - - - - - 0 01 06.81

Result:—Milwaukee Station No. 1, west, in longitude of Chicago observing Station No. 2, by a mean of the two sets of signals, + 0 01 06.82

	h. m. s.
Brought forward,	+ 0 01 06.82
Reduction to the steeple of the Roman Catholic Church on Jackson street, Milwaukee, -	— 0.5
Steeple of this church is west of the meridian of Chicago station No. 2, - - - -	+ 0 01 06.32
Longitude of Chicago station No. 2, west of the meridian of Greenwich, - - - -	+ 5 50 31.15

Determination 1*st.*

Longitude of the steeple of the Roman Catholic Church on Jackson street, Milwaukee, west of the meridian of Greenwich, - - -	+ 5 51 37.47

It will be seen that the coincidence in the results from the seven electric signals sent from Chicago to Milwaukee, in the above series, is not so close as those previously given in the cases of Waukegan and Racine, or as those which follow, for subsequent dates, as given from Chicago to Milwaukee.

There is an extreme difference in the results derived from the seven sent on the 23d of June from Chicago to Milwaukee, of seven one-hundredths ($\frac{7}{100}$) of a second of time. This I attribute to the little practice which the telegraph operator at Chicago had had, at that date, in this species of experiments.

On the afternoon of June 30th, I received information which made it necessary that I should go again to Milwaukee on public business. The journey afforded another opportunity to try the difference of longitude between that place and Chicago, by two new sets of observations entirely independent of those from which the above result is derived.

On the night of June 30th (being the night before I started on my second visit to Milwaukee), and on the night of my return to Chicago, namely, July 3d, I made, at Chicago, the observations already given under those two dates. They, combined with the following observations made at Milwaukee, and the telegraphic signals passed on the the night of July 1st, and in the day of July 3d, give the two additional determinations mentioned.

Observations for the Time at Milwaukee Station No. 2, July 1st, 1858.

This station was more convenient to my lodgings than No. 1. It is the centre, or point of intersection of the public walks, of the Court House Square.

From this point, if we run due east 235 feet, and then due north 29 feet, it will bring us perpendicularly under the apex of the steeple of the Roman Catholic Church on Jackson street. Hence, this steeple is 0''.29 north of the parallel, and 3''.165 of arc = 0*s*.21 of time east of the meridian of this observing station No. 2.

A point perpendicularly under the middle of the dome of the court house is due north 123 feet = + 1''.2 of latitude from this station No. 2.

The night was not very favourable for observations for the time. Passing clouds frequently obscured the stars which I desired to observe near the east and west prime vertical for that object. I could only get a single observation on α Andromedæ in the east, to balance against 5 observations on α Bootis, and 8 on α Coronæ Borealis, both in the west, for computing the time this night.

The sky to the north and the south was clearer, and hence more favourable to the observations for the latitude.

1858, *July* 1*st*. *At Milwaukee Station No.* 2.

Sidereal chronometer No. 2557, fast:		
By 5 observations on α Bootis, west (at 18*h*. 36*m*.) - -	*h. m. s.* 1 01 33.	
By 8 observations on α Coronæ Borealis, also west (at 19*h*. 03*m*.)	1 01 32.7	
		h. m. s.
By 13 observations on 2 west stars (at 18*h*. 50*m*.)		+ 1 01 32.85
By 1 observation on α Andromedæ, east (at 20*h*. 56*m*.)		+ 1 01 33.31
Result—Chronometer No. 2557, fast of sidereal time for this station (at 19*h*. 53*m*.) - -		+ 1 01 33.08

The following telegraphic signals were passed, before the observations for the time were made here. The weather was so cloudy, that no observations on the stars could be made previous to the time of night at which the telegraph was at our command for the signals. We had first to pass the signals, and take the chances of getting the time from observation afterwards.

Determination of the difference of Longitude between Chicago and Milwaukee, by electric signals for comparisons of time, July 1st, 1858.

Sidereal Chronometer No. 2557, fast, of Milwaukee, sidereal time, (at 17*h.* 18*m.* 48*s.* sidereal time,) 1*h.* 01*m.* 32*s*.47.

Rate per sidereal day, + 5*s*.66 ; or per sidereal hour, + 0*s*.236.

Mean Solar Chronometer No. 141, slow, of Chicago, mean solar time, (at 10*h.* 40*m.* 12*s.* mean time,) 4*m.* 52*s*.27.

Rate per mean solar day, + 0*s*.90 ; or per mean solar hour, + 0*s*.0375.

1st.—Chicago signals recorded at both stations.

Times of signals given at Chicago by mean solar Chronometer No. 141.	Correct Chicago mean solar time of Chicago signals.	Times of Chicago signals as noted at Milwaukee by sidereal Chronometer No. 2557.	Milwaukee correct sidereal time of Chicago signals.	Chicago reduced sidereal time of Chicago signals.	Difference of Longitude by each signal.—Milwaukee west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
10 35 20.	10 40 12.27	18 20 20.5	17 18 48.03	17 19 54.56	0 01 06.53
10 38 20.	10 43 12.27	18 23 21.	17 21 48.52	17 22 55.05	0 01 06.53
10 41 40.	10 46 32.27	18 26 41.5	17 25 09.01	17 26 15.60	0 01 06.59
10 44 10.	10 49 02.27	18 29 12.	17 27 39.50	17 28 46.01	0 01 06.51

1st Mean.—Electric signals sent from Chicago to Milwaukee, 0 01 06.54

2d.—Milwaukee signals recorded at both stations.

Times of signals given at Milwaukee by sidereal Chronometer No. 2557.	Times of Milwaukee signals as noted at Chicago by mean solar Chronometer No. 141.	Chicago correct mean solar time of Milwaukee signals.	Chicago reduced sidereal time of Milwaukee signals.	Milwaukee correct sidereal time of Milwaukee signals.	Difference of Longitude by each signal.—Milwaukee west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
18 35 25.	10 50 22.	10 55 14.25	17 34 59.01	17 33 52.47	0 01 06.54
18 38 25.5	10 53 22.	10 58 14.25	17 37 59.50	17 36 52.96	0 01 06.54
18 41 26.	10 56 22.	11 01 14.25	17 40 59.99	17 39 53.44	0 01 06.55
18 44 26.5	10 59 22.	11 04 14.25	17 44 00.48	17 42 53.93	0 01 06.55

2d Mean.—Electric signals sent from Milwaukee to Chicago, 0 01 06.545

1st Mean.—Electric signals sent from Chicago to Milwaukee, as above, - - - - - - - 0 01 06.540

Result:—The centre of the Court House Square at Milwaukee, is west, in longitude of Chicago, observing Station No. 3, by a mean of the two sets of signals, - - - + 0 01 06.54

	h. m. s.
Brought forward,	+ 0 01 06.54
Reduction to the steeple of the Roman Catholic Church on Jackson street, Milwaukee, -	— 0.21
Steeple of the Roman Catholic Church, Milwaukee, west of the Chicago observing station No. 3,	+ 0 01 06.33
Longitude of Chicago station No. 3, west of the meridian of Greenwich, - - - -	+ 5 50 31.2

Determination 2d.

Longitude of the steeple of the Roman Catholic Church on Jackson street, Milwaukee, west of the meridian of Greenwich, - - -	5 51 37.53

My duties detained me at Milwaukee until the afternoon rail road train of July 3d. The night of the 2d was cloudy, and part of it rainy, and not a star could be seen.

The 3d was clear, so I determined to try the result of a third series of telegraphic signals for the difference of longitude between the two places, which should rest for the Milwaukee time, on a set of equal altitudes of the sun observed with the sextant and artificial horizon, A. M. and P. M. The signals were passed by telegraph between the periods of the forenoon and afternoon observations.

I could not observe in the day time, either in the court house yard, or at station No. 1 of June 23d, because there were so many carriages, drays and persons on foot, constantly passing near by, that the artificial horizon of quicksilver was, I found while at those stations during the day, kept constantly agitated.

I was obliged therefore, to seek a more quiet position than either of those two. This I found in a vacant lot at the north east corner of Jackson and Martin streets.

The position here occupied I call Milwaukee Station No. 3. It is 890 feet north of the parallel, and 38 feet east of the meridian of the steeple before mentioned. Hence the reduction from this station No. 3, to the said steeple is — 8″.8 in latitude, and + 0″.512 of arc = + 0*s*.034 of time, in longitude.

The equal altitudes of the sun we accordingly observed as follows, viz:

1858, *July 3d.* *At Milwaukee Observing Station No.* 3.

Equal altitudes of the Sun, A. M. and P. M.

Observed double altitudes of the Sun's upper and lower limbs.	Times by sidereal Chronometer No. 2557 of equal altitudes of the Sun.		Elapsed sidereal time.	Equation of equal altitudes, in sidereal time.	Time by Chronometer of apparent noon.	Sidereal time of apparent noon.	Chronometer fast of sidereal time at apparent noon.
	A. M.	P. M.					
° ′ ″	*h. m. s.*	*h. m. s.*	*h. s.*	*s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
Up. limb, 106 09 50	5 18 55.8	10 23 45.6	5 05	+ 2.03	7 51 22.73	6 49 42.19	1 01 40.54
Up. limb, 106 58 10	5 21 17.9	10 21 23.8	5 00	+ 2.00	7 51 22.85	" " "	1 01 40.66
Lo. limb, 110 23 10	5 34 34.4	10 08 07.6	4 33	+ 1.93	7 51 22.97	" " "	1 01 40.78
Up. limb, 115 28 10	5 46 56.8	9 55 45.9	4 09	+ 1.89	7 51 23.24	" " "	1 01 41.05
Lo. limb, 115 28 10	5 50 12.3	9 52 29.6	4 02	+ 1.85	7 51 22.80	" " "	1 01 40.61

Result:—Chronometer No. 2557, fast, of sidereal time for the Milwaukee Observing Station No. 3, at apparent noon (say at 6*h.* 50*m.* sidereal time) of July 3d, 1858, by a mean of 5 pairs of equal altitudes of the Sun, - - - - - - - - - - + 1 01 40.73

Determination of the difference of Longitude between Chicago and Milwaukee, by electric signals for comparisons of time, July 3d, 1858.

Sidereal Chronometer No. 2557, fast, of Milwaukee, sidereal time, (at 8*h*. 00*m*. 47*s*. sidereal time,) 1*h*. 01*m*. 41*s*.01.

Rate per sidereal day, + 5*s*.66 ; or per sidereal hour, + 0*s*.236.

Mean Solar Chronometer No. 141, slow, of Chicago, mean solar time, (at 1*h*. 15*m*. 51*s*. mean time,) 4*m*. 51*s*.06.

Rate per mean solar day, + 0*s*.90 ; or per mean solar hour, + 0*s*.0375.

1st.—Chicago signals recorded at both stations.

Times of signals given at Chicago by mean solar Chronometer No. 141.	Correct Chicago mean solar time of Chicago signals.	Times of Chicago signals as noted at Milwaukee by sidereal Chronometer No. 2557.	Milwaukee correct sidereal time of Chicago signals.	Chicago reduced sidereal time of Chicago signals.	Difference of Longitude by each signal.—Milwaukee west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
1 11 00.	1 15 51.06	9 02 28.5	8 00 47.49	8 01 53.76	0 01 06.27
1 14 30.	1 19 21.06	9 05 59.	8 04 17.98	8 05 24.33	0 01 06.35
1 17 10.	1 22 01.06	9 08 39.5	8 06 58.47	8 08 04.77	0 01 06.30
1 20 00.	1 24 51.06	9 11 30.	8 09 48.95	8 10 55.23	0 01 06.28

1st Mean.—Electric signals sent from Chicago to Milwaukee, 0 01 06.30

2d.—Milwaukee signals recorded at both stations.

Times of signals given at Milwaukee by sidereal Chronometer No. 2557.	Times of Milwaukee signals as noted at Chicago by mean solar Chronometer No. 141.	Chicago correct mean solar time of Milwaukee signals.	Chicago reduced sidereal time of Milwaukee signals.	Milwaukee correct sidereal time of Milwaukee signals.	Difference of Longitude by each signal.—Milwaukee west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
9 17 35.	1 26 04.	1 30 55.05	8 17 00.22	8 15 53.93	0 01 06.29
9 20 35.5	1 29 04.	1 33 55.05	8 20 00.71	8 18 54.42	0 01 06.29
9 23 36.	1 32 04.	1 36 55.05	8 23 01.20	8 21 54.91	0 01 06.29
9 26 36.5	1 35 04.	1 39 55.05	8 26 01.69	8 24 55.40	0 01 06.29

2d Mean.—Electric signals sent from Milwaukee to Chicago, 0 01 06.29

1st Mean.—Electric signals sent from Chicago to Milwaukee, as above, - - - - - - - - 0 01 06.30

Result.—Milwaukee observing Station No. 3 is west, in longitude of Chicago observing Station No. 3, by a mean of the two sets of signals, - - - - - + 0 01 06.3

	h. m. s.
Brought forward,	+ 0 01 06.30
Reduction to the said steeple, - - -	+ 0.03
Steeple, west of the meridian of Chicago observing station No. 3, - - - -	+ 0 01 06.33
Longitude of Chicago station No. 3, - -	+ 5 50 31.20

Determination 3d.

Longitude of the said steeple, west of the meridian of Greenwich, - - - - -	5 51 37.53

Here are three singular coincidences in the determination of the difference of longitude between two places derived from time observations made with a sextant and an artificial horizon. We will present a fourth and then a summary of the whole.

I will first remark, that the time was obtained at Chicago afresh on my return hither on the night of the same day (July 3d); that the equal altitudes of the sun were observed and the signals passed, as will be seen by reference to the preceding record of the Chicago observations.

Late in the afternoon of July 5th, I was again summoned to go to Milwaukee on business connected with the harbour improvement there. I determined to make the journey the occasion of a fourth trial of the difference of longitude, by a set of observations that should render it entirely independent of the other three. Accordingly on the night of the 5th, I made the observations at Chicago given under that date in the preceding record.

My business in regard to the harbour improvement occupied me at Milwaukee all day of the 6th, and until the time for the afternoon train of cars to start for Chicago on the 7th. By that train I reached Chicago in time to make the observations already given under that date. They, and those of the 5th, gave a short run for the rate of the mean solar chronometer No. 141, at Chicago, and they also gave the absolute time for the meridian of Chicago within 21½ hours of the mean period of the telegraphic signals of the 6th.

After the duties of the day for the 6th were over at Milwaukee, I made the following observations for the time at station No. 3.

Two sets of time observations were made at that station this night, one set before exchanging the telegraphic signals with Chicago, and another set after those signals.

The mean of the two results was adopted for the mean period of the two sets, which corresponds very nearly (within half an hour) with the mean period of the signals, and thus leaves but that length of run of the sidereal chronometer between the period of getting its error from observation, and the mean period of the signals.

1858, *July 6th. Observations for the Time at Milwaukee Station No.* 3.

1*st Set. Before the Telegraphic Signals.*

	h.	m.	s.
Sidereal chronometer No. 2557, fast:			
By 12 observations on α Lyræ, east (at 15*h*. 39*m*.)	1	02	01.19
By 13 observations on α Bootis, west (at 16*h*. 04*m*.)	1	02	00.15
1*st Result—Before the Signals*—Chronometer No. 2557, fast of sidereal time for Milwaukee station No. 3 (at 15*h*. 52*m*.) - - -	+1	02	00.67

2*d Set. After the Signals.*

	h.	m.	s.
Sidereal chronometer No. 2557, fast:			
By 5 observations on α Coronæ Borealis, west (at 20*h*. 08*m*.) - - - - -	1	02	01.83
By 5 observations on α Andromedæ, east (at 20*h*. 22*m*.)	1	02	00.94
2*d Result—After the Signals*—Chronometer fast of sidereal time for this station (at 20*h*. 15*m*.)	+1	02	01.38
Do. do. (at 15*h*. 52*m*.) before the signals, as above, - - - - -	+1	02	00.67
Result adopted—Chronometer No. 2557, fast of sidereal time for Milwaukee station No. 3 (at 18*h*. 03*m*.) July 6th, - - - -	+1	02	01.

The above result for the time at Milwaukee, combined with the Chicago time-observations of July 5th and 7th, and applied to the following telegraphic signals, give us a fourth determination of the difference of longitude between Chicago and Milwaukee, entirely independent of the other three, as follows, viz.

Determination of the difference of Longitude between Chicago and Milwaukee, by electric signals for comparisons of time, July 6th, 1858.

Sidereal Chronometer No. 2557, fast, of Milwaukee, sidereal time, (at 17*h*. 03*m*. 22*s*. sidereal time,) 1*h*. 02*m*. 00*s*.78.

Rate per sidereal day, + 5*s*.27; or per sidereal hour, + 0*s*.22.

Mean solar Chronometer No. 141, slow, of Chicago, mean solar time, (at 10*h*. 05*m*. mean time,) — 4*m*. 49*s*.1.

Rate per mean solar day, + 0.32*s*; or per mean solar hour, + 0*s*.0133.

1st.—Chicago signals recorded at both stations.

Times of signals given at Chicago, by mean solar Chronometer No. 141.	Correct Chicago mean solar time of Chicago signals.	Times of Chicago signals, as noted at Milwaukee by sidereal Chronometer No. 2557.	Milwaukee correct sidereal time of Chicago signals.	Chicago reduced sidereal time of Chicago signals.	Difference of Longitude by each signal.—Milwaukee west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
10 00 20	10 05 09.1	18 05 23.	17 03 22.22	17 04 28.42	0 01 06.20
10 03 20	10 08 09.1	18 08 23.5	17 06 22.71	17 07 28.91	0 01 06.20
10 06 20	10 11 09.1	18 11 24.	17 09 23.20	17 10 29.41	0 01 06.21
10 09 20	10 14 09.1	18 14 24.5	17 12 23 69	17 13 29.90	0 01 06.21
10 12 10	10 16 59.1	18 17 15.	17 15 14.18	17 16 20.37	0 01 06.19

1st Mean.—Electric signals sent from Chicago to Milwaukee, 0 01 06.202

2d.—Milwaukee signals recorded at both stations.

Times of signals given at Milwaukee by sidereal Chronometer No. 2557.	Times of Milwaukee signals as noted at Chicago, by mean solar Chronometer No. 141.	Chicago correct mean solar time of Milwaukee signals.	Chicago reduced sidereal time of Milwaukee signals.	Milwaukee correct sidereal time of Milwaukee signals.	Difference of Longitude by each signal.—Milwaukee west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m s.*	*h. m. s.*	*h. m. s.*
18 23 15.	10 18 09.	10 22 58.09	17 22 20.34	17 21 14.15	0 01 06.19
18 26 15.	10 21 08.5	10 25 57.59	17 25 20.33	17 24 14.14	0 01 06.19
18 29 16.	10 24 09.	10 28 58.09	17 28 21.32	17 27 15.13	0 01 06.19
18 32 16.5	10 27 09.	10 31 58.09	17 31 21.82	17 30 15.62	0 01 06.20
18 35 17.	10 30 09.	10 34 58.09	17 34 22.31	17 33 16.11	0 01 06.20

2d Mean.—Electric signals sent from Milwaukee to Chicago, 0 01 06.194

1st Mean.—Electric signals sent from Chicago to Milwaukee as above, - - - . - - 0 01 06.202

Result:—Milwaukee Station No. 3, west in longitude of the meridian of Chicago observing Station No. 3, by a mean of the two sets of signals this night, - - + 0 01 06.20

	h. m. s.
Brought forward,	+ 0 01 06.20
Reduction to the church steeple as before (see Determination 3d) - - - - -	+ 0.03
Steeple, west of the meridian of Chicago observing station No. 3, - - - - -	+ 0 01 06.23
Longitude of Chicago observing station No. 3, -	5 50 31.20

Determination 4th.

Longitude of the said steeple, west of the meridian of Greenwich, - - - - -	5 51 37.43

SUMMARY. Longitude of this steeple:

By Determination 1st, of June 23d, 1858, -	5 51 37.47
By Determination 2d, of July 1st, ,, -	5 51 37.53
By Determination 3d, of July 3d, ,, -	5 51 37.53
By Determination 4th, of July 6th, ,, -	5 51 37.43

Mean, giving each determination an equal weight.

Longitude of the steeple of the Roman Catholic Church on Jackson street, Milwaukee, west of the meridian of Greenwich, - -	5*h*. 51*m*. 37*s*.5
Equal, in arc, to - - -	87° 54′ 22″.5

I confess I was surprised, when the several computations were completed, at the very close coincidence of these four determinations. They may be due, in some measure, to a fortunate concurrence of circumstances of which I am altogether unconscious. No one can expect such results, always, from observations with a sextant of the ordinary size, depending on the steadiness of the hand for its support; yet I do not hesitate to say, from long experience in observing with astronomical instruments—both portable and those permanently mounted on stone pillars—that the correct time may be obtained by a practised observer, with a good sextant and artificial horizon, within a small fraction of a second, by twenty or thirty minutes time spent in observing on two stars of nearly the same declination, whose places, as given in the catalogues, are well determined—the one to be observed when near the east and the other when near the west prime-vertical.

I also believe, from long experience, that the latitude of a place may be ascertained by a few hours' work in a single clear night, with the same apparatus and a good time-keeper—either a first quality pocket watch, or a chronometer—to withinone hundred or one hundred and fifty yards of space, measured on the meridian; that is to say, to within 3″ to 4″.5 of arc. This is quite near enough for the projection of geographical maps, even on the largest scale usually adopted. Even a nearer approximation often occurs from such instruments and observations, by a few hours' work in a single night.

By a series of observations on four pairs of stars, well chosen under the rule before given—a condition that may often be secured in two consecutive nights—the latitude may, we believe, be ascertained, with such an apparatus, to within one second of arc.

There is such a vast extent of our country whose geography is very imperfectly laid down, that this peculiar branch of practical astronomy should be much encouraged amongst our countrymen who travel either for purposes of scientific research, or for pleasure and amusement. The requisite apparatus is easily transported, and may be packed within the space of an ordinary travelling valise, except the time-keeper, which should essentially be carried in a wheeled vehicle, either in hand, or on the person of the traveller.

3d. *Observations for the Latitude of Milwaukee.*

These were made on the nights of the 1st and 6th of July, at stations No. 2 and No. 3, already described, as follows, viz.

1858, *July 1st. At Milwaukee Station No. 2, in the middle of the Court House Square.*

	° ′ ″
By 18 circum-meridian altitudes of α Aquilæ (Altair) south, - - - - - -	43 02 30.2
By 12 altitudes of α Ursæ Minoris (Polaris) north,	43 02 36.8
Result—Latitude of station, by this night's observations, - - - - - -	43 02 33.5
Reduction to the steeple of the Roman Catholic Church on Jackson street, - - - -	+ 0.29
Latitude of this church steeple by this night's observations, - - - - - -	43 02 33.79

1858, *July 6th.* *At Milwaukee Station No.* 3.

	° ′ ″
By 17 altitudes of *α* Ursæ Minoris (Polaris) north,	43 02 39.12
By 26 circum-meridian altitudes of *α* Aquilæ (Altair) south, - - - - - -	43 02 45.77
Result—Latitude of this station, - - -	43 02 42.45
Reduction to the steeple of the Roman Catholic Church on Jackson street, - - -	— 8.8
Latitude of this steeple by this night's observations,	43 02 33.65
Do. by the observations of July 1st, above given,	43 02 33.79
Result adopted—Latitude of the steeple of the Roman Catholic Church on Jackson street, Milwaukee, by a mean of both nights' observations, -	43 02 33.7
Longitude of the same, west of the meridian of Greenwich, as before given, 5*h.* 51*m.* 37*s.*5 = -	87 54 22.5

From these two last expressed results, combined with our harbour survey, we present the following table of positions in the city of Milwaukee.

POSITIONS IN MILWAUKEE.	North Latitude.	Longitude West from the Meridian of Greenwich.	
		In Arc.	In Time.
	° ′ ″	° ′ ″	h. m. s.
1st. Steeple of the Roman Catholic Church on Jackson Street, - -	43 02 33.7	87 54 22.5	5 51 37.5
2d. Dome of the Court House, -	43 02 34.6	87 54 25.7	5 51 37.7
3d. Centre of the Court House public square, - - - - - -	43 02 33.4	87 54 25.7	5 51 37.7
4th. The intersection of the middle of Milwaukee Street with the middle of Mason street, - - -	43 02 27.2	87 54 31.4	5 51 38.1

The American Almanac for the present year (1858) gives the position of Milwaukee, as follows, viz.

Latitude, - - -	43° 03′ 45″ N.
Longitude, west Greenwich, -	87° 57′ 00″

which, if our determination be correct, is an error in the assigned geographical position of this place, of two and fifty-five hundredths miles (2.55 miles) on an azimuthal course of N. 58° 06′ 19″ W. from the true position.

VI. MADISON, THE CAPITAL OF WISCONSIN.

On the 24th of June I went from Milwaukee to Madison, intending to observe there in the evening, and, if possible, to exchange telegraphic signals with Chicago for determining the difference of longitude. The night was, however, cloudy and rainy, and no observations could be made, either for the time or the latitude.

On the 25th the weather remained somewhat cloudy, and was unsettled until a late hour of the night; so much so, that no signals could be passed by the telegraphic wires. The following observations were, however, made during three-fourths of an hour, at intervals of clear sky, in the early part of the evening, for the time, and after the weather had cleared, at a late period of the night, for the approximate latitude, viz.

1*st. Observations for the Time. Station No.* 1.

At a point 95 feet = + 0″.94 of latitude north of the parallel, and 175 feet = — 0*s*.16 of time east of the meridian of the centre of the dome of the State Capitol.

1858, *June* 25*th.*

	h. m. s.
Sidereal chronometer No. 2557, fast:	
By 13 observations on α Lyræ, east (at 15*h.* 43*m.*)	1 06 50.41
By 15 observations on α Bootis, west (at 16*h.* 08*m.*)	1 06 50.43
Result—Chronometer No. 2557, fast of sidereal time for this station (at 15*h.* 56*m.*) -	+ 1 06 50.42

2*d. Observations for the Latitude of Station No.* 1. *Same Night.*

	° ′ ″
By 19 observed circum-meridian altitudes of α Ophiuchi, south, - - - - -	43 04 40.9
By 21 altitudes of α Ursæ Minoris (Polaris) north,	43 04 41.5
Result—Latitude of station No. 1 (approximate)	43 04 41.2
Reduction to the dome of the Capitol, - -	— 0.9
Result—Latitude of the State Capitol at Madison, Wisconsin (approximate), - - -	43 04 40.3 N.

Owing to unfavourable weather, the only result of this visit to Madison was the obtaining of the approximate latitude as above given.

On the 19th of July I made another visit to Madison, and returned to Chicago on the evening of the 21st.

Observations for the time, at the Chicago Station No. 2, on the 18th and 21st, will be found among the preceding records.

The night of the 19th was not very favourable for observations at Madison. I was enabled to observe nine altitudes of α Lyræ, east, for the time, but the sky was so cloudy the rest of the night that no observations could be made on a star west for eliminating any small errors that might appertain to the partial result obtained from α Lyræ.

Telegraphic signals were, however, exchanged with Chicago, with a view to obtaining an approximate result for the longitude of Madison in case I should not be able to get a more satisfactory set of time-observations before leaving that place.*

Fortunately such an opportunity occurred on the next night, when, occupying a station (No. 2) immediately in rear of the Baptist church, on Carroll street, between Washington and Morris streets, the following observations were made: From this station, to a point perpendicularly under the apex of the steeple of this church, is N. 45° E. 90 feet; from thence to a point perpendicularly under the centre of the dome of the State Capitol, we ran, first, N. 45° E. 268 feet, and then due north 320 feet. Hence the reduction from this Madison Station No. 2 to the dome of the State Capitol, is, in latitude, + 5″.68, and in longitude—3″.41 in arc,=—0*s*.23 in time.

Observations for the Time at Madison Station No. 2. *Approx. Latitude*, 44° 04′ 33″.1 *N.* 1858, *July* 20*th*.

Sidereal chronometer No. 2557, fast:

	h.	*m.*	*s.*
By 8 observations on α Aquilæ (Altair) east (at 17*h*. 05*m*.) - - - - -	1	09	12.95
By 13 observations on α Bootis, west (at 17*h*. 37*m*.)	1	09	15.05
Result—Chronometer No. 2557, fast of sidereal time for this station, No. 2 (at 17*h*. 21*m*.)	+ 1	09	14.

The above result for the time at Madison, combined with the time-observations at Chicago on the nights of July 18th and 21st, and the telegraphic signals passed on the night of the 20th, gives the longitude of Madison as follows, viz.

* *Note.* The approximate time, computed from those observations on α Lyræ, on the night of the 19th, and the telegraphic signals of that night, give, as the approximate longitude of the State Capitol, west of Greenwich, 5*h*. 57*m*. 32*s*.5, which is 0*s*.75 greater than the result adopted from the observations and signals of the night of July 20th.—J. D. G.

Determination of the difference of Longitude between Chicago and Madison, Wisconsin, by electric signals for comparisons of time, July 20th, 1858.

Sidereal Chronometer No. 2557, fast of Madison sidereal time (at 18*h*. 16*m*. sidereal time), + 1*h*. 09*m*. 14*s*.2.

Rate per sidereal day, + 5*s*.39. or per sidereal hour, + 0*s*.2245.

Mean Solar Chronometer No. 141, slow of Chicago mean solar time (at 10*h*. 28*m*. mean time), 104*m*. 42*s*.16.

Rate per mean solar day, + 0*s*.42. or per mean solar hour, + 0*s*.017.

1st.—Chicago signals recorded at both stations.

Times of Signals given at Chicago, by mean solar Chronometer No. 141.	Correct Chicago mean solar time of Chicago signals.	Times of Chicago signals, as noted at Madison, Wis. by sidereal Chronometer No. 2557.	Madison correct sidereal time of Chicago signals.	Chicago reduced sidereal time of Chicago signals.	Difference of Longitude by each signal. Madison west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
10 23 40.	10 28 22.16	19 25 10.5	18 15 56.30	18 22 57.12	0 07 00.82
10 26 40.	10 31 22.16	19 28 11.	18 18 56.79	18 25 57.61	0 07 00.82
10 29 40.	10 34 22.16	19 31 11.5	18 21 57.28	18 28 58.10	0 07 00.82
10 32 30.	10 37 12.16	19 34 02.	18 24 47.77	18 31 48.57	0 07 00.80
10 35 40.	10 40 22.16	19 37 12.5	18 27 58.25	18 34 59.08	0 07 00.83

1st Mean.—Electric signals sent from Chicago to Madison, Wis., 0 07 00.818

2d.—Madison, Wisconsin, signals recorded at both stations.

Times of signals given at Madison by sidereal Chronometer No. 2557.	Times of Madison, Wis. signals, as noted at Chicago, by mean solar Chronometer No. 141.	Chicago correct mean solar time of Madison signals.	Chicago reduced sidereal time of Madison signals.	Madison correct sidereal time of Madison signals.	Difference of Longitude by each signal. Madison west of the meridian of Chicago.
h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
19 46 15.	10 44 41.	10 49 23.15	18 44 01.56	18 37 00.72	0 07 00.84
19 49 15.5	10 47 41.	10 52 23.15	18 47 02.05	18 40 01.21	0 07 00.84
19 52 16.	10 50 41.	10 55 23.15	18 50 02.54	18 43 01.70	0 07 00.84
19 55 15.5	10 53 40.	10 58 22.15	18 53 02.03	18 46 01.19	0 07 00.84
19 58 15.5	10 56 39.5	11 01 21.65	18 56 02.02	18 49 01.18	0 07 00.84

2d Mean.—Electric signals sent from Madison, Wis. to Chicago, 0 07 00.84

1st Mean.—Electric signals sent from Chicago to Madison, Wisconsin, as above, 0 07 00.818

Result:—Madison Station No. 2, west, in longitude, of Chicago observing station No. 2, by a mean of the two sets of signals, + 0 07 00.83

	h. m. s.
Brought forward,	+ 0 07 00.83
Reduction to the dome of the State Capitol,	— 0.23
Dome of State Capitol, west of Chicago Station No. 2,	0 07 00.6
Longitude of Chicago station No. 2, - -	5 50 31.15
Result—Longitude of the dome of the State Capitol at Madison, Wisconsin, west of the meridian of Greenwich, - - - - -	5 57 31.75
Equal, in arc, to - - - -	89° 22′ 56″.25
Latitude of the same point (approximate) as before given, - - - -	43° 04′ 40″.3 N.

This being a State Capital, the above determination will be verified by further observations, when an opportunity shall occur.

In all the computations of the observations for the time and the latitudes, the Apparent Right Ascensions and Declinations of the Stars have been taken from the British Nautical Almanac for the year 1858.

J. D. GRAHAM,
Member of the Society.